

Vehicle routing problems with the use of multi-agent system

Lukasz Chomatek, Aneta Poniszewska-Maranda

Institute of Information Technology, Technical University of Lodz, Poland

Workshop on Software Services
Timisoara, Romania, June 2011

Motivations for agents in vehicle routing problems

- increasing number of vehicles on roads - increase of popularity of GPS devices
- Internet sites - compute efficient route from one point to another and fulfill user needs
 - saving of time - path computed automatically by system
 - finding some information - system can show the way to the nearest ...
 - informing about situation on road, e.g. traffic jams, speed cameras, road works, accidents.

Problems and solutions

- **paper:** proposition to solve the path finding problem with the use of multi-agent system
- multi-agent system - cooperation between autonomous software agents to complete certain task

Groups of agents for SSSP problem based on road network hierarchy

- graph constructing agents
- agents interacting with system user
- miscellaneous agents

Algorithms for SSSP

- typical algorithms for SSSP problems do not use any preprocessing of the graph
- hierarchical algorithms include some kind of preprocessing of graph - to short the time required to process a single query

Most popular SSSP solving algorithms

- Dijkstra's algorithm
- Bellman-Ford algorithm
- A* algorithm

Hierarchical algorithms

Ideas of Hierarchical Path Views algorithms

- base road network was split into some fragments - places of split were chosen by its geographical coordinates
- connections which are outside generated fragments belong to higher hierarchy level
- division and level transfer is an iterative process

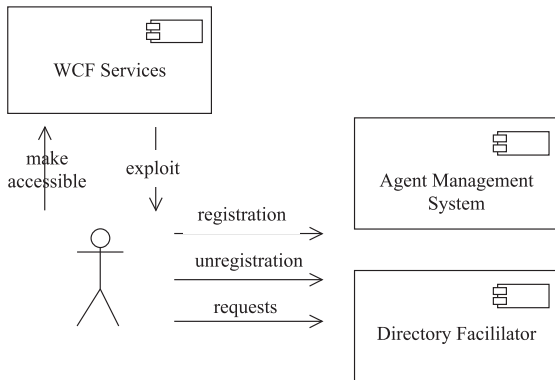
Multi-agent systems

- standards of architecture for multi-agent systems described by FIPA organization
- multi-agent system consists of number of Agent Platforms - parts of system used to host the agents
 - *Message Transport System (MTS)* used by agents for communication
 - *Agent Management System (AMS)* represents catalog of existing agents
 - *Directory Facilitator (DF)* stores information about services provided by agents

Agent approach in information system security (1)

- SOA used in process of creation of multi-agent systems
- more elastic, interaction between agents is simpler and its safety on upper level
-
- agent uses service directories: *Directory Facilitator* and *Agent Management System*
- makes accessible certain services and profits by services offered by other agents

Agent approach in information system security (2)



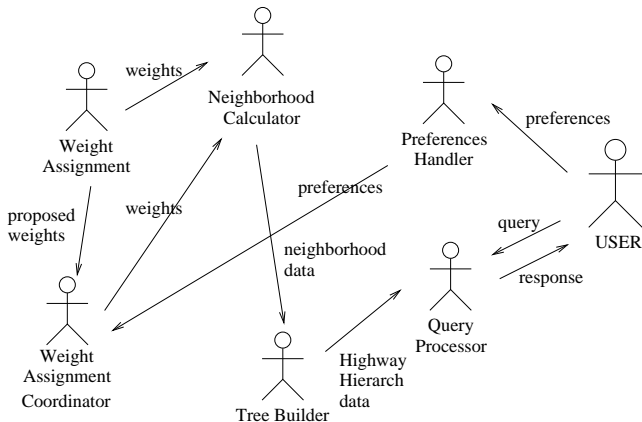
Application of multi-agent system (1)

- two main assumptions made for multi-agent system to build Highway Hierarchies graph
 - system should take into account user's preferences (i.e. route should be the shortest, traveling time should be lowest) and environmental conditions (i.e. weather, time of a day)
 - computations should be done concurrently, where it is possible

Application of multi-agent system (2)

- weights of road segments must be assigned using different criteria, such as length, average traveling time, speed limits, etc
- decided to introduce some number of reactive agents that collect the data from different road segments
- these agents work associated with nodes to get information about edges connected to node
- or they related to edges and list of edges can be divided into some parts to analyze by single agent

Types of agents in Highway Hierarchies algorithm



Conclusions

- problems of efficient vehicle routing
- more and more drivers use devices to support planning of their itinerary
- new solutions/algorithms to improve applications for finding the best routes taking into consideration different criteria, static and dynamic
- agent and multi-agent approach - interesting solution to solve problems with vehicle routing and finding optimal itinerary